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PRODUCTIVITY IMPROVEMENT THROUGH QUALITY CIRCLE: A CASE STUDY AT CALDERYS NAGPUR

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ABSTRACT

Involvement and participation of the workers in the quality and productivity improvement projects in manufacturing industries through Quality Circles results in great benefits for the organizations. Quality Circles (QCs) have proved to be a very effective technique of involving the workers in this mission of companywide quality and productivity improvement and getting solved many a work related problems and implemented quality and productivity improvement projects through them. The concept of Quality Circles originated in Japan has been well adopted and widely used even in the Indian industries. The paper reports a case study of application of this simple yet powerful technique for improving the productivity at Calderys plant at Butibori Nagpur. It demonstrates how the various steps of problem solving are followed as per the QC methodology and can be a useful guide to new quality circles or new members in the quality circles in manufacturing industries.

KEYWORDS: Workers Participation, Quality Circle & Productivity Improvement

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Original Article

INTRODUCTION

There are various methods of increasing the workers' participation in the organizational functioning with the objective of creating a sense of belongingness among them, largely driven by the Human Resource Development Departments of the organizations on one side and a plethora of techniques for improving the performance, productivity and quality, driven mainly by the Production Departments on the other side, followed in the manufacturing organizations. However, Quality Circles are a wonderful blend of these two approaches for achieving both these things simultaneously. A very large number of organizations in India are using the quality circles to achieve the twin objectives of people involvement and performance improvement. Quality Circle prescribes a systematic approach to problem solving or performance improvement comprising of twelve steps. This paper discusses the successful implementation of the quality circle in Calderys plant at Butiboti Nagpur and demonstrates all the steps used for selecting and solving a problem.

Quality Circles

Quality Circle (QC) is a group of workers, normally 8 to 12, working in a related area or doing similar work in an organization which is formed on a voluntary basis for solving the work related problems being faced by them. In this, the workers themselves identify the various problems, select the problems to be solved on a priority basis, find out a solution to the selected problem by using various problem solving techniques, propose the solution

to the management for approval and they implement the solution. The role of Management is that of a facilitator.The concept of Quality Circles was originated in Japan in 1962. It has spread all over the world and is implemented in large number of manufacturing industries though with varying degrees of success.

Implementation of Quality Circles

Though the Quality Circle (QC) in itself is just a group of workers, Quality Circle as an approach to problem solving or performance improvement is a powerful technique as it follows a step by step approach to problem solving using the seven QC tools. While implementing the QCs the workers are trained in the use of the problem solving techniques and data based approach to problem solving. A new QC structure is created with roles assigned to Top Management, Steering Committee, Coordinator, Facilitator, Leader, Deputy Leader and Members of the Circles. These circles take up small improvement or problem solving projects and execute them in 3-4 months. Then they go for the next problem.

Benefits of Quality Circles

Quality Circles lead to solving of the work related problems taken up by the circle members in a time bound manner which result in improvement in the quality, productivity, safety, delivery time, reduction in the costs, accidents, fatigue etc. as tangible benefits as well as the self and mutual development of the workers, increased confidence, job satisfaction, morale of the workers and improved management –worker relationship as the intangible benefits.

LITERATURE REVIEW

Extensive literature has been published in reputed research journals about the implementation of the quality circles in the manufacturing industries and the factors affecting their success or failure. The relevant literature mainly from the point of view of the implementation steps was referred.

Jyoti Prakash Majumdar et al, [2011] have discussed the reasons for the possible failure of the quality circles in the manufacturing industries and the issues that crop up during the implementation of QCs. They have identified three problem areas namely organizational readiness issues, implementation issues and operational issues which can come in the way of success of Quality Circles.

Shantanu Welekar et al, [2013] describes the process of launching the quality circles in an industry and the steps for their implementation. Chiragkumar S. Chauhan et al, [2014] has demonstrated the use of seven quality control tools namely Flowchart, Cause and Effect Diagram, Check Sheet, Paerto Diagram, Histogram, Scatter Plot and Control Charts and PDCA cycle are useful in solving the problems through QCs. The objectives of quality circles, procedure for the formation and implementation of quality circle including the structure of the quality circles, roles and responsibilities of all the stakeholders are discussed at length by Anad Jayakumar et al, [2015].

Shantanu Kulkarni et al, [2017] elaborate a case study of improving the productivity in a medium scale manufacturing industry by the use of quality circle. Review of the literature provided good guidance about the practical implementation of the QCs in industry and the use of various QC tools and problem solving techniques for solving the problems and improving the performance in an organization.

ABOUT CALDERYS, NAGPUR

A case study was carried out by forming a Quality Circle at Calderys Plant at Butibori, Nagpur. The circle took up

a small but important problem and successfully implemented the solution by following the QC methodology. Calderys Plant located at Butibori, Nagpur is one of the three manufacturing plants of the company in India. The plant was commissioned by ACC in 1996. Subsequently ACC divested the business and the plant was taken over by ICICI Venture Capital funds in 2005 and got renamed as Ace Refractories. In 2007 the unit became a part of Imerys and was named as Ace Calderys and in 2012 the unit became Calderys India Refractories Ltd. Nagpur refractory works. It is dealing with wide range of products ranging from Basic Monolithics, Alumina, Alumina –SiC-C, Carbon Monolithics, Tap Hole Clays, Ramming mass, Single & 2- Component Plastics, Injection materials etc. and caters to all types of Industries, viz Cement, Power, I&S, Foundry, Petrochemical, various Ferrous & Non ferrous industries.

CASE STUDY - APPLICATION OF QC FOR IMPROVING THE PRODUCTIVITY

The paper discusses the application of the quality circle at Calderys plant right from the stage of problem identification to the successful implementation of the solution. Various QC tools like Brain Storming, Comparative Sheet, Poka Yoke, ABC Analysis, Data Collection,3 P Analysis, Flow Diagram, Bar Chart, P.D.C.A. Cycle,4W & H, Check Sheet, Smart Analysis, Milestone Chart, Cause & Effect Diagram were used.

Information about the Circle

Table 1: Details of the Quality Circle Studied

No of Members	4
No of Problem Identified	57
No of 'A' type of Problems	51
Priority Problems	9
No of Problems Solved	10
Current Problems	1
Total Meetings	20
Attendance Percentage	80%
Date & Time of Meeting	Fri. 2 to 3 pm
Place of Meeting	Maintenance Room

Problem Selection

Selection of the right problem is very crucial for the success of the QC activity and considerable analysis is done in selecting the right problem among the various existing problems to be solved. The first step is to list down all the problems that could be affecting the work performance.

Identification of Work Area Problems

The Team members had detailed brain storming on following aspects to identify the work area problems: (1) Production Logbook information (2) Complaints received from different departments (3) Record from breakdown slips (4) Day to day experience.

Total 57 Problems were identified and Listed. The identified problems were classified into A, B and C categories as per the following criteria

Table 2: A.B.C. Analysis of Problem

A	Problems which are within the control & capacity & can be independently solved by the circle members.
B	Problems which the circle can solve with the help of resources available with other departments.
C	Problems which are in management preview.

Table 3: List of Problems

Sr. No	Identified Problem	Classification
1	Difficulty in Diverting Flap Damper of packing Hopper	A
2	Low capacity of skip Hoist	C
3	Vibration in Skip Hoist while ascending	A
4	Low depth of pit of Skip Hoist	C
5	Frequent chocking of pipe line of pneumatic conveyor	A
6	Difficulty in tearing of jumbo bag in skip Hoist	A
7	Flying of dusting while emptying of jumbo bags in skip Hoist	A
8	Slipping of transfer car belt during operation	A
9	Leakage of material from transfer car	A
10	Leakage of material from Vibrating tray	A
11	Problem in load Hoper of feeding point	A
12	Poor Lighting near transfer car	A
13	Leakage of material due to jerky movement of transfer car	A
14	Stopping of transfer car near hopper due to malfunctioning of limit switch of hopper	A
15	Contamination of material due to dirt near transfer car	A
16	Damage of forklift due to breaker near door	B
17	Problem in maintenance due to not lifting of two ton material by forklift	A
18	Filling of raw material in excess of the capacity in jumbo bags.	A
19	Difficulty in maintenance of break of skip hoist for the fitter.	A
20	Problem of pressure of compressor air	A
21	Jamming of discharge valve of fine conveying system	A
22	Spillage of material of motor gear box of skip hoist.	A
23	Spillage of material at the top position of skip hoist.	A
24	Panel board of fine conveying not at the right place.	B
25	Slipping of wire rope from pulley of fine conveying.	A
26	Difficulty in replacing the flexible pipe of fine conveying.	A
27	Air leakage from air flexible pipe of fine conveying.	A
28	Leakage of fine material from top floor of fine hopper.	A
29	Flying of dust in large amount from hopper while discharging the bag in fine conveyor.	A
30	Oil leakage from coupling of transfer car.	A
31	Presence of moisture in the bag of fine material.	B
32	Formation of lumps in the fine raw material.	B
33	Loose hanging of electric wire near fine conveying.	A
34	Loose hanging of flexible air pipe of fine conveying.	A
35	Leakage of material from the batch car of production.	A
36	Air leakage from the air pipe of batch car.	A
37	Leakage of material near the mixer.	A
38	Flying of dust in large amount during mixer discharge.	A
39	Material leakage from gate of skip hoist (production).	A
40	Spillage during material discharge from batch car to belt conveyor.	A
41	Material spillage while discharging the material from main belt conveyor to skip hoist.	A
42	Wastage of raw material near feeding point.	A
43	Flying of dust in large amount while discharging material from main belt to skip hoist.	A
44	Loud noise while discharging the charge from skip hoist to mixer.	A

Table 3: Contd.,		
45	Leakage of material from packing belt of packing machine.	A
46	Leakage of material from catch gate of packing machine.	A
47	Variation in the weights of bags coming out from catch gate of packing machine.	A
48	Frequent slipping of chain of packing belt of packing machine.	A
49	Frequent jamming of valve of packing hopper.	A
50	Frequent occurrence of fault in proximity sensor of hopper.	A
51	Leakage of air from flexible pipe of raw material hopper.	A
52	Frequent jamming of flap of hopper.	A
53	Stitching machine frequently going out of order.	A
54	Spillage generation at feeding point of hopper	A
55	Tearing of jumbo bag during handling.	A
56	Wire rope damage at conveying system during conveying	A
57	Disturbance in home position of batch car.	A

The number of problems in each category and their problem nos. are tabulated.

Table 4: No of Problems in each Category

Classification	Problem Nos.	Total
A - Type	1,3,5,6,7,8,9,10,11,12,13, 14,15,17,18,19,20,21,22, 23,25,26,27, 28,29,30,33,34,35,36,37, 38,39, 40,41,42,43,44, 45,46,47, 48,49, 50,51,52,53,54,55,56,57	51
B - Type	16,24,31,32.	4
C - Type	2,4.	2

In the Quality Circle Approach it is recommended that first the circles should attempt to solve the A Category Problems and then proceed for B and C Category problems. The next step in selecting the problem is to apply the 3P Analysis as below

Table 5: 3 P Analysis for Problem Selection

P1- PROPRIETARY	Problems are distinguished on the basis of Companies Need, Strategic Planning & Objectives
P2- PRIORITY	Problems are distinguished by giving Weightage by members using Weightage method
P3- PREFERENCE	One problem is selected by deciding the Preference

Problems were Proprietary wise classified in four groups with reference to need of the industry,

Proprietary Basis of Classification P1

1) Loss of Production 2) Spillage 3) Wastage 4) Safety Health & Environment

The QC members gave the Weightages to the Proprietary of Problems as per below.

Table 6: Weight Age Chart on the Basis of Proprietary (Weight age out of 10)

Sr. No	Proprietary based Classification	Member 1	Member 2	Member 3	Member 4	Total
1	Loss of Production (LOP)	9	8	10	7	**34**
2	Wastage	8	6	6	5	25
3	Spillage	6	5	5	2	18
4	Safety Health & Environment	8	7	2	6	23

As members have given maximum Weight age to Loss of Production (LOP) hence problems related to LOP are considered having highest propriety. Such problems are enlisted and the data of Loss of Production is collected.

Priority Basis of Classification P2

Table 7: Group Selection for Priority

Sr. No	Classification	Problem Nos.	Total
1.	Loss of Production	1,5,11,13,14,15,19,20,26,30,34,36,42,48,51,52,53,54,55,56,	20
2.	Spillage	3,8,9,10,12,17,18,21,37,39,40,44,47,49,50,57	16
3.	Wastage	6,7,28,29,38,43	06
4.	Safety, Health & Environment	22,23,25,27,33,35,41,45,46	9

Table 8: Loss of Production Data

Four Months Data Collection for Loss of Production (In MT)								
S. N	Problems	May'2017	June'2017	July'2017	Aug'2017	Total (in MT)	%, Loss	Cumm. %
1	**Problem no. 56**	**80**	**70**	**75**	**80**	**305**	**25.72%**	**25.72%**
2	Problem no. 11	10	15	20	25	70	5.90%	31.62%
3	Problem no. 13	15	25	33	35	108	9.11%	40.73%
4	Problem no. 12	10	10	10	20	50	4.22%	44.94%
5	Problem no. 16	20	10	15	10	55	4.64%	49.58%
6	Problem no. 30	10	15	25	5	55	4.64%	54.22%
7	Problem no. 26	15	20	20	15	70	5.90%	60.12%
8	Problem no. 49	20	15	30	25	90	7.59%	67.71%
9	Problem no. 48	20	20	25	15	80	6.75%	74.45%
10	Problem no. 45	25	15	10	25	75	6.32%	80.78%
11	Problem no. 28	12	10	10	20	52	4.38%	85.16%
12	Problem no. 47	14	20	5	30	69	5.82%	90.98%
13	Problem no. 36	17	15	15	10	57	4.81%	95.78%
14	Problem no. 17	15	10	15	10	50	4.22%	100.00%

For better realization of comparative Loss of production due to these problems Pareto Diagram is drawn,

Pareto Diagram

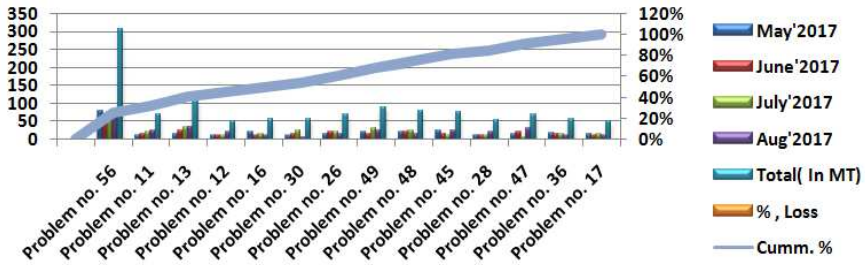

Figure 1

It is observed that problem no 56 is responsible for highest Loss of Production in percentage. Hence problem no. 56 is chosen for solving. This problem is of wire rope damage at conveying system during conveying of jumbo bags.

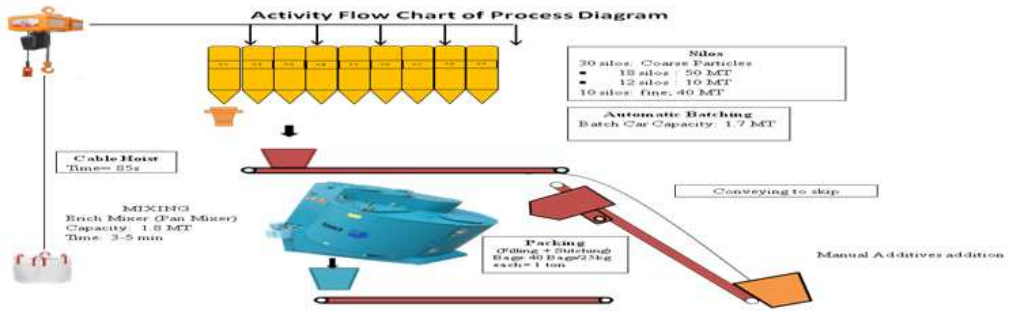

Figure 2

Problem Definition

To know the impact of the problem, the company flow chart was studied.

Defining the Problem

(1) At the conveying point, raw material jumbo bags were not being kept in right manner (2) Wire rope swings and gets damaged while lifting jumbo bags of raw material. Because of these reasons the production gets affected.

OBJECTIVES

(1) To reduce the total maintenance cost (2) To fulfill the customer requirement on time/ as per their required delivery dates (3) To reduce the breakdown time and increase the productivity.

For systematic approach to problem solving, the members planned the action on time schedule, through milestone chart.

Problem Analysis

The problem is analyzed by using 4W1H approach and study of actual data.

4 W & 1H METHOD

- What is the problem? Wire rope damage
- When it happens? During conveying
- Where does it happen? At raw material conveying station
- Which things are affected? Conveying, Production, Manpower
- How does it happen? **At the time of conveying, Jumbo bags were lifted from any location and wire rope is touching with metallic structure, which is causing wire rope damage**

Milestone Chart

The following Milestone chart was prepared to solve the Wire rope damage at conveying system during conveying"

Table 9: Project Start ON: 15.06.2017 Target Date: - 02.09.2017

Sr. No	Activity	Date	Weeks											
			1	2	3	4	5	6	7	8	9	10	11	12	13
1	Selection of Problem	15.06.2017 to 14.07.2017													
2	Definition of Problem	15.07.2017 to 21.07.2017													
3	Analysis of Problem	22.07.2017 to 28.07.2017													
4	Identification of Cause	29.07.2017 to 02.08.2017													
5	Finding Out Root Cause	03.08.2017 to 8.08.2017													
6	Data Analysis/ Collection	09.08.2017 to 15.08.2017													
7	Development Solution	16.08.2017 to 23.08.2017													
8	Trial Implementation & Check Result	24.08.2017 to 30.08.2017													
9	Regular Implementation	02.09.2017 onwards.													

Data Collection and Analysis

The data related to the impact due to problem was collected

Table 10: Data Collection (Impact due to Problem)

	Loss of Production due to breakdown in conveying system				
Month	Wire Rope Breakdown	Total Loss of Production	Miscellaneous Cost	Manpower Cost	Total Loss
May to Aug' 2017	7	305 MT	Rs 359150/-	Rs.37350 /-approx.	Rs.396500 /-approx.

Finding out Causes

Through brainstorming the workers tried to find out the causes

(1) Raw materials jumbo bags are not keeping in right manner (2) Operator miss judgment (3) Space was not defined as per conveying station (4) Total lifting height is too high (5) Design defect. The root cause analysis was done

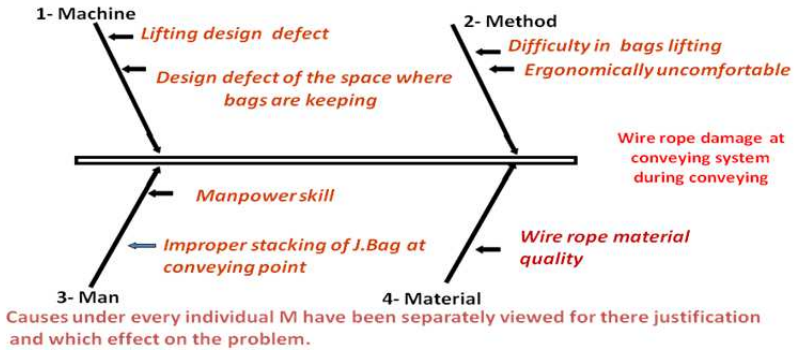

Figure 4

CAUSES & SUBCAUSES

For comparative assessment of the adverse effect of the causes, two major causes effecting to the breakdown of the hoist were taken and the Why? Why? Analysis was done for these two Causes

Table 11: Use of Why-Why Analysis

Reason	Why	Why
Specific space is not available	Design defect	Design defect.
Bags are not keeping properly	Design defect	Unskilled manpower

Development of Solution

After brain storming members had suggested four solutions. The solutions were evaluated on the basis of cost and ease of implementation as given below.

Table 12

Suggestions	Remark	Accepted /not Accepted
Change in conveying system	Costly	Not accepted
Big belt conveyor fitting from ground floor	Costly	Not accepted
Hoist replacement with EOT crane	Costly	Not accepted
Barricading to be done at conveying station	Easy to make	Accepted

Trial Implementation of Solution

For implementing the solution PDCA approach was used..

PLAN – The work was planned and a schedule was prepared.

Table 13

Plan	Responsibility	Schedule
1. Fabrication of barricading 2. To make the checklist in order to sustain the improved system, to avoid breakdown 3. White wash & Painting work	Member - 1 Member – 2 & 3 Member - 4	16.08.2017 to 23.08.2017

DO - After provision of material etc. the members took up the execution

Table 14

Work	Responsibility
• 2" MS pipe searched from scrap • Total fabrication work done for barricading • Painting and demarcation done	As in the planning sheet complete responsibility were assigned to each member.

CHECK – The proper implementation of the plan was checked

(1) Bags are kept at the center point of hoist (2) Lifting can be done easily (3) Bags are not swinging and rope is not coming to the damage point (4) Total 8 bags can be stored at one time (5) Ergonomically comfortable

Performance checking was done by all the members & results noted down on next sheet format

Table 15: Action Plan, Do, Check, Action Cycle

Date	MONTH
	Crane Breakdown due to Wire Rope Damage
24.08.2017 to 30.08.2017	**0 (Time)**

The comparison of before and after pictures shows how the bags are properly arrange and how baricates are helping in the proper layout of the bags.

BEFORE **AFTER**

Figure 6

Table 16: Observation Shows the Loss of Production in Relevance to Prob. No. 56 AFTER Implementation of Solution

Date	Month Crane Breakdown due to Wire Rope Damage	Observation During Trial
24.08.2017 to 30.08.2017	In the Month of Aug-Sep 2017 : No Breakdown	During trial we observe that all jumbo bags are lifting easily, And not contacting to damage point

Cost of the Project

Old scrap was used for fabrication of the barricade by taking help of 1 welder & 1 fitter, which are regular employees. The total cost incurred was as below.

Manpower cost: Rs. 900/- approx + welding / cutting cost Rs. 1200 approx + painting/white wash/others: Rs. 5700/- approx

Total Cost: Rs.7800/- approx.

Regular Implementation and Follow Up

After confirming good results from trial implementation the solution was found satisfactory and hence was implemented on a permanent basis. Following checklist was prepared for inspection and maintenance purpose.

Table 17: Need Based Check List & Follow Up

Frequency	Description
Daily	Cleaning at conveying station
Weekly	Checking of the condition of barricades & it's position, As well as lubrication of wire rope
Monthly	Checking of the wire rope of crane hoist with the help of maintenance department.

Benefits Obtained

The benefits obtained are classified into tangible and intangible benefits.

Table 18: Tangible Benefits

Date	Crane Breakdown due to Wire Rope Damage	Avg. Cost of Saving
24.08.2017 TO 20.09.2017	0 (Time)	Rs 29300 Approx. /- per month

Total production has been increased by 80 MT/month

Total saving achieved = Rs. 29300/ Month (Rs 7700/- from Manpower + Rs 21600/- from maintenance)

Intangible Benefits: (1) Increased Motivation among the workers as the conveying place is in good condition (2)

Higher Confidence (3) Clean work place (4) Ease in material conveying

CONCLUSIONS

Quality Circle formed in the Calderys plant at Butibori, Nagpur successfully followed the QC methodology to identify and solve the selected problem. The problem of damage to wire rope was selected and solved. The solution resulted in substantial savings and also increases the productivity. The case study demonstrates how quality circle can be very effectively used in improving the productivity in manufacturing organizations.

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